BULLETIN

OF THE

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Botanical Gardens.*

By N. L. Britton.

Origin and Development.

The cultivation of plants within small areas for their healing qualities by the monks of the middle ages appears to have been the beginning of the modern botanical garden, although these mediaeval gardens doubtless took their origin from others of greater antiquity. Botanical gardens were thus primarily formed for purely utilitarian purposes, although the aesthetic study of planting and of flowers must doubtless have appealed to their owners and visitors. Their function as aids in scientific teaching and research, the one which at present furnishes the dominating reason for their existence, did not develop much, if at all, before the 16th century, and prior to the middle of the 17th century a considerable number existed in Europe, in which this function was recognized to a greater or less degree, of which those at Bologna, Montpellier, Leyden, Paris and Upsala were, perhaps, the most noteworthy. The ornamental and decorative taste for planting had meanwhile been slowly gaining ground, as well as the desire to cultivate rare or unusual species, and during the 18th century attained a high degree of development. Many persons of wealth and influence fostered this taste and became, through the employment of men skilled in botany and horticulture, generous patrons of science.

* Vice-Presidential address befere Section G, American Association for the Advancement of Science, Buffalo, N. Y., August 24, 1896.

The world was searched for new and rare plants, which were brought home to Europe for cultivation, and many sumptuous volumes, describing and delineating them, were published, mainly through the same patronage. The older gardens were essentially private institutions, but as the rights of the people became more and more recognized, many existing establishments and an increasing number of newly founded ones became, to a greater or less extent, open to the public, either through an admittance fee or without charge. The four main elements of the modern botanical garden have thus been brought into it successively:

1. The utilitarian or economic.
2. The aesthetic.
3. The scientific or biologic.
4. The philanthropic.

These four elements have been given different degrees of prominence, depending mainly upon local conditions, some gardens being essentially aesthetic, some mainly scientific, while in our public parks we find the philanthropic function as the underlying feature, usually accompanied by more or less of the aesthetic and scientific.

The Economic Element.—In the broadest extension of this department of a botanical garden there might be included, to advantage, facilities for the display and investigation of all plants and their products directly or indirectly useful to man. This conception would include forestry, pharmacognosy, agriculture, pomology, pathology and organic chemistry, and in case the management regards bacteria as plants, bacteriology.

The display of the plants may be effected by growing such of them as will exist without protection in the locality in a plot, more or less individualized, commonly known as the Economic Garden, while those too tender for cultivation in the open are grown in the greenhouses, either in a separate house or section, or scattered through the several houses or sections, in the temperatures best adapted to their growth. The display of plant products, best accompanied by mounted specimens of the species yielding them, by photographs and by plates, is accomplished by the Economic Museum, where these are arranged in glass or glass-fronted cases, suitably classified and labeled. It is believed

that the most useful results are obtained by arranging this museum by the products themselves, and thus not in biologic sequence, but by bringing together all drugs, all fibres, all woods, all resins; where the same product is used in more than one industry the exhibit may be duplicated, more or less modified, without disadvantage.

The investigation of economic plants and their products is accomplished through the Scientific Department, and few valuable results can be reached unless the scientific equipment is well developed. The two departments must work conjointly, both on account of the necessity of knowing just what species is under investigation, its structure, distribution and literature, and in order that the most approved and exact methods may be used in the research. Any idea that the scientific element can be dispensed with in connection with economic studies is palpably untenable.

Teaching and research in agriculture, pomology and plant pathology are so well organized in America, through our National Department of Agriculture and our numerous agricultural colleges and schools, that there is no great necessity for providing elaborate equipments for those branches in botanical gardens. But in case the endowment of a garden were sufficiently large to enable them to be successfully prosecuted, in addition to more necessary work, there can be no doubt that important additions to knowledge would be obtained. On the other hand, no such liberal allowances have been made with us for forestry or pharmacognosy, and research and instruction in these sciences must prove of the greatest benefit to the country.

The Aesthetic Element.—The buildings, roads, paths and planting of a botanical garden should be constructed and arranged with reference to tasteful and decorative landscape effect. The possibilities of treatment will depend largely upon the topographical character of the area selected and the natural vegetation of the tract. The buildings required are: A fire-proof structure or structures for museum, herbarium, libraries, laboratories and offices; a glass house with compartments kept at several different temperatures for exhibition, propagation and experimentation, or several separate glass houses; and to these will usually be added dwelling houses for some of the officers, a stable and other minor buildings.

The character, number and sizes of the buildings generally depend on financial considerations. In placing the structures intended for the visiting public, considerations of convenient access, satisfactory water supply and the distribution of crowds must be borne in mind, in connection with the landscape design. The planting should follow, as nearly as possible, a natural treatment, except immediately around the larger buildings and at the entrances, where considerable formality is desirable for architectural reasons. It is especially desirable that as much natural treatment as possible should be given to the areas devoted to systematic planting—herbaceous grounds, frutecetum, arboretum. The rectilinear arrangement of plant beds found in most of the older gardens has become abhorrent to landscape lovers, and the sequence of families desired can usually be quite as well obtained by means of curved-margined groups.

The cultivation of decorative plants, and especially the fostering of a taste for them, and the bringing of unusual or new species to attention and effecting their general introduction, are important functions of a botanical garden. For the accurate determination of these plants, information concerning their habits and structure, and suggestions regarding the conditions of their growth, the aesthetic side must rely on the scientific.

The Scientific or Biologic Element.—The important relations of the scientific department to the economic and aesthetic have already been alluded to. The library, herbarium, museums and laboratories are the sources whence exact information regarding the name, structure, habits, life-processes and products of plants are derived, and they are the more useful as they are the more complete and thoroughly equipped. It is practically impossible for any one library to have all the literature of botany and related sciences; any one herbarium to possess an authentic and complete representation of all species of plants, or any one museum to be thoroughly illustrative; absolute perfection along these lines cannot be obtained, but the more closely it is approximated the better the results. The research work of the scientific department should be organized along all lines of botanical inquiry, including taxonomy, morphology, anatomy, physiology and palaeontology, and the laboratories should afford ample opportunities and equipment for their successful prosecution.

The arrangement of the areas devoted to systematic planting, and the proper labeling of the species grown, are important duties of the scientific department. The sequence of classes, orders and families is usually made to follow some "botanical system." It is highly desirable that this should be a system which indicates the natural relations of the families, as understood at the time the garden is laid out, and be elastic enough to admit of subsequent modification, as more exact information relative to those relationships is obtained. The weight of present opinion is overwhelmingly in favor of an arrangement from the more simple to the more complex, and this will apply not only to the systematic plantations, but to the systematic museum and the herbarium.

The scientific possibilities of a botanical garden are the greater if an organic or cooperative relationship exists between it and a university, thus affording ready facilities for information on other sciences.

The Philanthropic Element.—A botanical garden operates as a valuable philanthropic agency, both directly and indirectly. Its direct influence lies through its affording an orderly arranged institution for the instruction, information and recreation of the people, and it is more efficient for these purposes than a park, as it is more completely developed and liberally maintained. Its indirect, but equally important, philanthropic operation is through the discovery and dissemination of facts concerning plants and their products, obtained through the studies of the scientific staff and by others using the scientific equipment.

Number and Distribution of Botanical Gardens.

There are somewhat over 200 institutions denominated botanical gardens, but only a few of them meet the requirements of the foregoing sketch. Some are essentially pleasure parks, with the plants more or less labeled; most of them pay some attention to taxonomy and morphology; many to economic botany; while a small number are admirably equipped in all branches of the science.

I have drawn freely on Prof. Penhallow's first annual report of the Montreal Botanical Garden, published in 1886, for the following approximate statement of the number in different countries:

Algeria, 1.
Australia, 5.
Austro-Hungary, 13.
Belgium, 5.
Brazil, 2.
Canada, 1.
Canary Islands, 1.
Cape of Good Hope, 3.
Ceylon, 1.
Chili, 1.
China, 1.
Cochin China, 1.
Denmark, 2.
Ecuador, 1.
Egypt, 1.
France, 22.
Germany, 36.
Great Britain and Ireland, 12.
Greece, 1.
Guatemala, 1.
Guiana, 1.
Holland, 4.
India, 7.
Italy, 23.
Japan, 1.
Java, 1.
Malta, 1.
Mauritius, 1.
Natal, 1.
New Zealand, 1.
Norway, 1.
Peru, 1.
Philippine Islands, 1.
Portugal, 3.
Reunion, 1.
Roumania, 2.
Russia, 16.
Servia, 1.
Siberia, 1.
Spain, 2.
Straits Settlements, 1.
Sweden, 6.
Switzerland, 4.
Tasmania, 1.
United States, 10.
West Indies, 6.

Notes on some Foreign Gardens.

1. Buitenzorg, Java. This is the largest botanical garden, occupying some 1,100 acres, at altitudes from sea level to about 6,000 feet. It was founded by the Dutch government in 1817, and has been well supported. Affording, as it does, highly favorable conditions for the growth of tropical and subtropical plants under natural conditions, it has yielded most important results, especially in taxonomy and plant physiology, many of which have been published in the ten large volumes of its "Annales."

2. The Royal Botanic Gardens at Kew are situated on the south bank of the Thames, about six miles west of Hyde Park Corner. They are reached by several railway routes, the time from Charing Cross being about 40 minutes, by steamer and by omnibus lines. The present area of the gardens is about 260 acres, an addition having been made during the past year. These world-famed gardens originated in the exotic garden of Lord Capel, in 1759. In 1840 they were adopted as a national establishment and opened as a public park. The botanic garden proper occu-

pies about 70 acres, and the remainder is given to arboretum and pleasure grounds. There are two main greenhouses: 1. The palm house, 362 feet long, the central dome rising 66 feet; 2. The temperate house, of which the central portion is 212 feet long, 137 feet broad and about 60 feet high, flanked by wings which give a total length of about 580 feet, the whole covering between one and one and one-half acres of ground. There are also fourteen other houses, grouped in two ranges and more or less connected, given to special collections. There are three botanical museums: 1. Devoted to economic products; 2. to miscellaneous products; 3. to timbers. There is also a large museum hall given to the exhibition of floral paintings by the late Marienne North. There is a small laboratory equipped for research in physiological botany. The herbarium and library occupy the old palace of the King of Hanover, near the main entrance to the garden, and they are the largest and most complete in the world. The herbaceous ground is planted in long parallel beds and contains several thousand species. The arboretum is thoroughly illustrative of all trees that will grow in the open at Kew, and the shrubs are, for the most part, cultivated in areas by themselves. There are numerous special features, such as the rock garden, the bamboo garden and the American garden.

The research work of Kew is principally economic and taxonomic. Around it centre the 24 botanical gardens and botanical stations of the British Colonies, which are manned chiefly by men who have studied or worked at Kew. The principal publications at present emanating from Kew are:

1. The Kew Bulletin of Miscellaneous Information.
2. Hooker's Icones Plantarum.
3. The Continuation of Hooker's Flora of India.
4. The Continuation of the Flora of Tropical Africa.
5. Annual Reports.
6. The Index Kewensis.

The monographs and separate writings of its staff of scientific men are too numerous to review at this point.

3. The Royal Botanical Garden of Berlin is situated in the southwestern part of the city, but a project for moving it out into the country is now being seriously considered. The palm house

reaches a height of about 90 feet, being the highest one yet constructed, and too high for satisfactory operation. The botanical museum is very extensive and has series of economic, systematic and archaeological collections. The herbarium is one of the largest in the world. The systematic beds are arranged on a strictly modern sequence, and portions of the garden are devoted to plant geography and plant biology. The arboretum is not extensive. Among special features may be mentioned the alpine garden and the collections of Cacti. The garden is an institute of the University, where the principal laboratories are situated. There is also an institute of plant physiology with a small separate garden. The official publications of the Berlin Garden are the "Notizblatt" and annual reports. A series of volumes of "Jahrbücher" was issued some years ago. The publications of the garden staff are voluminous and cover all lines of botanical inquiry.

4. The long-established "Jardin des Plantes," the gardens of the Museum of Natural History at Paris, are situated in the heart of the city, fronting on the Seine. The conservatories are grouped near the main museum building at one end of the grounds, are very large and contain a great variety of plants. The botanical library, laboratories, and the enormous herbarium are in a separate older building. The systematic beds are arranged in rows; owing to the limited size of the area devoted to them, they are much crowded, but contain a splendid assortment of species. But little space is given to trees; there are, however, some famous specimens. Many valuable contributions to the literature of botany along all its lines have emanated from this grand institution for over 100 years, published for the most part, in the "Annales" and "Archives" of the Museum of Natural History, and in the Bulletin of the Botanical Society of France.

5. The Botanical Garden of the University of Vienna was established about 1754, and is located in the heart of the city. There are here very important and extensive museums, herbaria and libraries, and one large fine greenhouse. The systematic plantations occupy the larger portion of the tract, and special areas are devoted to the cultivation of medicinal and other economic plants, to an arboretum of native trees, and to groups illustrating plant geography. The garden and associated laboratories

provide equipment for the prosecution of all lines of botanical research.

6. The Botanical Garden of Geneva was founded in 1817, and is situated in the heart of the city, near the University. There are two small greenhouses, a very large and important herbarium and library, and a small museum. The laboratories of the University are extensive and well equipped, affording capital facilities for work along all the lines of botanical investigation. The De Candolle herbarium and library, and the Boissier herbarium and library, which are near by, afford, in connection with the collections of the garden, unsurpassed facilities for taxonomic study.

7. The Royal Botanic Garden of Edinburgh covers about 60 acres, of which about one-half was added to the older portion some 12 years ago; there are possibilities of still further enlargement. The main greenhouses have a frontage of about 200 feet, the palm house rising 70 feet, and there are six small special houses. The botanical museum, lecture room and laboratories are in one building, the large herbarium and library in another. The systematic plantations of herbaceous species are extensive, the rock garden being an especially strong feature. The development of arboretum and frutecetum in the newer portion of the tract has made good progress. The institution is in intimate relationship with the University, nearly all the instruction in botany being given at the garden. The research work has been extensive, along taxonomic, morphologic and physiologic lines.

8. The Royal Botanic Garden of Dublin, situated at Glasnevin, just without the city, was founded through the influence of the Honorable and Honorable Dublin Society, in 1790, was for many years supported by this Society with the aid of government grants, and was transferred to the Science and Art Department in 1877. It includes about 40 acres of undulating land, bounded to the north by the small river Tolka. There are eight greenhouses, most or them rather old, but containing a valuable collection. There is a small botanical museum and herbarium. The systematic herbaceous plantations are irregularly shaped beds, arranged in a somewhat radial manner. The arboretum and frutecetum occupy about one-half of the area.

9. The Brussels Botanical Garden lies in the heart of the city

and embraces not more than ten acres of land, of which one-half is given to arboretum. The greenhouses are large but old. There is a very extensive herbarium and library. The systematic beds are arranged as quadrants of a circle, separated by concentric and radial paths. Special areas are devoted to ornamental and economic plants. Owing to the restricted size of the area available a very dense grouping of plants is necessitated. The research work accomplished here has been mainly taxonomic. The Botanical Society of Belgium has its headquarters at the garden.

10. The Imperial Botanical Garden at St. Petersburg is in close affiliation with the Academy of Sciences and the University. There is here a famous herbarium, a large botanical library and museum, and commodious and well-stocked greenhouses. The garden publishes "Acta," and many researches prosecuted there are printed in the Bulletin and Memoirs of the Imperial Academy.

11. The Royal Botanic Garden of Trinidad, situated at Port of Spain, was established in 1818, and now occupies about sixty-three acres, with some outlying plantations. There is a vast collection of tropical plants in cultivation, an extensive botanical library and herbarium and a small laboratory. The garden publishes "Annual Reports" and "Bulletin," dealing especially with topics of economic application.

12. The Botanical Department of Jamaica, West Indies, operates extensive gardens at Kingston, smaller ones at Castleton, and the several large Cinchona plantations. The scientific collections and library are valuable. The department publishes "Annual Reports" and "Bulletin," especially devoted to economic botany.

13. McGill University, at Montreal, Quebec, carries on a small botanical garden in connection with its laboratories. The Montreal Botanic Garden, begun in 1885, on about 75 acres of ground in Mount Royal Park, was soon abandoned, owing to political complications.

14. Among other foreign gardens of which mention must be made, and of which a description would be interesting if our time allowed, are those at Munich, Würzburg, Tübingen, Stockholm, Copenhagen, Upsala, Zurich, Ceylon, Calcutta and Oxford.

Botanical Gardens in the United States.

The first botanical garden established in America was begun by John Bartram in Philadelphia, in 1728. In it he placed a considerable number of plants obtained in the course of his extensive travels. The plot still remains, including the family homestead, somewhat modified, and it is a pleasure to know that it will be preserved as public ground.

André Michaux, in the latter part of the last century, planted gardens at Charleston, S. C., and New Durham, N. J., but they were essentially nurseries from which he sent seeds and plants to Europe.

In the year 1801 Dr. David Hosack, then professor of botany and materia medica in Columbia College, purchased twenty acres of ground in New York city, and called it the Elgin Botanic Garden; in this tract he accumulated, with great labor during the next ten years, a very large and valuable collection of plants. The institution was transferred to the State of New York, through an act of the Legislature, in 1810, and was then known as the Botanic Garden of the State of New York. It was subsequently granted to Columbia College. Funds for its maintenance were not provided, however, and it was ultimately abandoned. Two catalogues of its plants were issued by Dr. Hosack, one in 1806, and another in 1811. The condition of botanical gardens in America at that time is indicated by the following note in Dr. Hosack's catalogue of 1806:

"I learn, with pleasure, that a Botanic Garden is proposed to be established near Boston, and connected with the University of Cambridge. The Legislature of Massachusetts, with a munificence which does them honor, have granted, for this purpose, a tract of land, the value of which is estimated at thirty thousand dollars; and several individuals have evinced their liberality and love of science by voluntary subscriptions, to the amount of fifteen thousand dollars, towards the establishment and support of that institution. Another is also begun at Charleston, S. C., and a third is contemplated in New Jersey, in connection with the College of Princeton."

In the year 1824 there was published at Lexington, Ky., the "First Catalogues and Circulars of the Botanical Garden of Tran-

sylvania University at Lexington, Ky., for the year 1824," by W. H. Richardson, M. D., President of the Board of Managers, and C. S. Rafinesque, Ph.D., Secretary. This rare pamphlet, which is not recorded in Dr. Call's very complete life and writings of Rafinesque, is of 24 pages, and is printed alternately in English and French. It is essentially an appeal for plants and material for the garden, and a list of species that it could furnish to kindred institutions. This garden was evidently short-lived, inasmuch as in Rafinesque's "Neogenyton," of the following year, 1825, he remarks, "I mean, therefore, to indicate and propose in this small essay, many of the numerous new genera of plants detected or ascertained, some of which were indicated last year, 1824, in the Catalogue of the botanical garden which I have tried in vain to establish in Lexington."

The principal gardens at present operated and in course of development in the United States are as follows:

1. The Botanic Garden of Harvard University, at Cambridge, Mass., founded in 1805. There are about seven acres of land under cultivation, a small greenhouse and a famous herbarium and library from which have flowed during the past 40 years voluminous and invaluable contributions to taxonomy and morphology, especially of North American plants. There is also a small morphologic laboratory. The main laboratories and museums connected with the institution are situated in other of the Harvard buildings a short distance away. The system of garden, libraries, museum, laboratories and herbaria operated by Harvard College is one of the most complete in existence. It is hard to say, indeed, in what respect it is not ideal, except in the rather wide distance separating the several elements and the small amount of land available for planting.

2. The Arnold Arboretum of Harvard University, at Jamaica Plain, Mass., was founded through a bequest of $100,000, made about 1870, by Mr. James Arnold, of Providence, R. I., to three trustees, to be used for the improvement of agriculture or horticulture. The trustees wisely determined to devote it to forestry and dendrology, and effected cooperative agreements with Harvard College and the City of Boston, which have now given us the greatest tree museum in existence, freely open to the visiting pub-

lic. The planted area is about 160 acres, and will be materially increased in size. A small museum, library and herbarium building has been erected near the main entrance. The great *Silva of North America* and the journal *Garden and Forest* are noteworthy publications from this noble institution.

3. The Botanic Gardens of the United States Department of Agriculture, at Washington, have an extensive range of greenhouses and a large tract of land under cultivation. The herbarium of the department, now deposited with the United States National Museum, is very large and is at present increasing more rapidly than any other in America. There is a somewhat effective working library, which greatly needs material enlargement, and several poorly located and equipped laboratorias, in which a vast amount of important investigation is being accomplished, under very unfavorable conditions, which urgently demand improvement. Publications include: Bulletin of the Botanical Division, Bulletin of the Division of Forestry, Bulletin of the Division of Plant Pathology and Physiology, Contributions from the United States National Herbarium, Year-book of the United States Department of Agriculture, and circulars of the several divisions.

4. The Missouri Botanical Garden, at St. Louis, Mo., was established in 1889, through the provisions of the will of Mr. Henry Shaw, who for over thirty years previously had been bringing together material for it on the land about his residence, which was known as Shaw's Garden. There were in all some 670 acres devised to the institution under the will of the generous and philanthropic founder, and from the income yielded by much of this land, not nearly all the area being required for garden purposes, the institution derives its large maintenance fund, which will certainly be greatly increased as the land becomes more valuable, and will supply an income sufficient to operate the institution in the most effective manner. There are several greenhouses, a very large and valuable herbarium and library, while the laboratories of the Shaw School of Botany, at Washington University, are in close relationship to the garden. Much important research, principally taxonomic, has been prosecuted. Publications consist of seven volumes of Annual Reports and nine "Contributions from the Shaw School of Botany."

5. The Botanical Garden of the Michigan Agricultural College was begun in 1877. There are now about three acres under high cultivation, exclusive of the aboretum and decorative grounds, which together cover several acres. There are several small greenhouses, an herbarium of about 60,000 specimens, a good botanical library and extensive, well-equipped laboratories.

6. The University of California, at Berkeley, has a botanical garden of several acres, established some years ago, in which a large number of plants are grown. It furnishes a valuable adjunct to the work of the botanical department, which has well-appointed laboratories, a working library and a large herbarium.

7. The University of Pennsylvania has recently established a garden of about three acres in the immediate vicinity of its building, in Philadelphia, and has many species under cultivation. The extensive and well-appointed laboratories of its School of Biology, good library facilities and a small herbarium afford capital opportunity for research, especially in physiology and morphology.

8. Smith College, at Northampton, Mass., has also recently established a botanical garden, on the campus.

9. The Buffalo Botanical Garden, in South Park, Buffalo, N. Y., was commenced in 1893, and has since made rapid and encouraging progress. A small range of greenhouses has been built, and others are planned. A beginning has been made in accumulating a library and herbarium, and much permanent planting has been accomplished.

10. The New York Botanical Garden. The establishment of the New York Botanical Garden was authorized by the Legislature in 1891, and the enabling act was amended in 1894. The enterprise was inaugurated and the legislation procured by a committee of the Torrey Botanical Club, appointed in 1889. The Act of Incorporation provided that when the corporation created should have raised or secured by subscription a sum not less than $250,000 the Commissioners of Public Parks were authorized to set apart and appropriate a portion of one of the public parks, not exceeding 250 acres, and the Board of Estimate and Apportionment was authorized to issue bonds, aggregating the sum of $500,000, for the construction and equipment, within the grounds, of the necessary buildings. The subscription of $250,000 required

by the Act of Incorporation was completed in June, 1895, and the Commissioners of Public Parks, in the following month, formally appropriated 250 acres of the northern part of Bronx Park for the purposes of the Garden. Since that time the preparation of plans for the development of the tract has been steadily progressing, including designs for the museum building and a large horticultural house. This planning is still in progress, in charge of a commission of architects, engineers, gardeners and botanists, who will complete their work within a short time, and be ready to submit a complete scheme to the Board of Managers during the coming autumn. Meanwhile, much preliminary work has been accumplished in clearing the ground, in grading, in the planting of borders, in the establishment of an extensive nursery, and in the accumulation of herbarium, museum and lirbary material. Through a coöperative agreement entered into with Columbia University, the herbarium and botanical library of the University will be deposited with the Garden, and most of the research and graduate work of the University in botany will be carried on in the museum building.

The endowment fund has been materially increased, and about 430 persons have become annual members of the Garden, contributing ten dollars a year each to its support. The publication of a Bulletin has been commenced by the issue, in April, of the first number of Volume I.

N. L. Britton.

Proceedings of the second Annual Meeting of the Botanical Society of America.

Buffalo, N. Y., August 21st and 22d, 1896.

Subsequent to a meeting of the Council on the afternoon of Friday, August 21st, the Society met, with the retiring President, Dr. Wm. Trelease, in the chair, who introduced the President-elect, Prof. C. E. Bessey. Dr. Bessy addressed the Society in a brief and suggestive manner. The election of officers for the year 1897–'98 resulted as follows:

President, Prof. J. M. Coulter.
Vice-President, Prof. C. S. Sargent.
Treasurer, Mr. Arthur Hollick.
Secretary, Prof. C. R. Barnes.
Councillors, Dr. B. L. Robinson, Mr. F. V. Coville.

The Secretary reported the death of Mr. Michael Schuck Bebb, and a committee was appointed to prepare and report a suitable minute for record. The committee subsequently reported the following, which was unanimously adopted:

The Botanical Society of America desires to place on record an expression of esteem for its deceased member, Michael Schuck Bebb, who died on December 5, 1895, at San Bernardino, Cal. His published studies upon the difficult genus *Salix* have brought him to high rank as a professional botanist, and American botany owes to him a debt of gratitude, as one of its most distinguished representatives.

JOHN M. COULTER,
N. L. BRITTON,
CONWAY MACMILLAN,
Committee.

Mr. C. H. Peck, of Albany, N. Y., and Mr. B. T. Galloway, of Washington, D. C., were unanimously elected active members.

The question of the advisability of holding a midwinter meeting in addition to the regular annual meeting was discussed at length, and referred to the Council, with power. Professors Trelease, Atkinson and Britton were appointed a committee to nominate additional members.

The address of President Trelease, on "Botanical Opportunity," was delivered on the evening of August 21st, before a large and interested audience, and publication for it was requested from "Science" and the "Botanical Gazette."

The following papers were read on Saturday afternoon:

"Some Characteristics of a Fresh-water Insular Flora," by Prof. Conway MacMillan.

"A Species of *Eleocharis*, new to North America," by Prof. N. L. Britton.

The following were read by title:

"The Philosophy of Species-making," by Prof. L. H. Bailey.

"Some Problems in Sporophyll-transformation among dimorphic ferns," by Prof. Geo. F. Atkinson.

The Treasurer's report showed a balance on hand of $556.30.

The members present at the meetings were: G. F. Atkinson, L. H. Bailey, C. R. Barnes, C. E. Bessey, E. G. Britton, N. L. Britton, J. M. Coulter, A. Hollick, C. MacMillan, W. Trelease, L. M. Underwood.

Titles of Papers read before the Section of Botany, A. A. A. S., Buffalo Meeting, August 24-26, 1896.

Prof. N. L. Britton, Vice-President of the Association and Chairman of the Section, presided; Prof. Geo. F. Atkinson, Secretary.

Prof. Britton's Vice-Presidential address, on "Botanical Gardens," was delivered on the afternoon of Monday, August 24th. It is printed in full in this issue of the BULLETIN.

Papers were read as follows:

1. *The Relation of the Growth of Leaves to the CO_2 of the Air.* By D. T. MACDOUGAL.
2. *Directive Forces operative in Leaf-rosettes.* By R. N. DAY.
3. *On Crataegus coccinea and its Segregates.* By N. L. BRITTON.
4. *The Distribution of the Species of Gymnosporangium in the South.* By L. M. UNDERWOOD and F. S. EARLE.
5. *Morphology of the Canna flower.* By L. H. BAILEY.
6. *A Comparison of the Flora of Erie Co., Ohio, with that of Erie Co., New York.* By E. L. MOSELEY.
7. *The Significance of simple and compound Ovaries.* By C. E. BESSEY.
8. *On the bacterial Flora of Cheddar cheese.* By H. L. RUSSELL.
9. *The Terminology of Reproduction and reproductive Organs.* By C. R. BARNES.
10. *A comparative Study of the Development of some Anthracnoses in artificial Cultures.* By BERTHA STONEMAN.
11. *The Development of the vascular Elements in the primary Root of Indian Corn.* By W. W. ROWLEE.
12. *Some Remarks on Chalazogamy.* By J. M. COULTER.
13. *The Habitats of the rarer Ferns of Alabama.* By L. M. UNDERWOOD.

14. *On the Stem-anatomy of certain Onagraceae.* By FRANCIS RAMALEY.
15. *The Point of Divergence of Monocotyledons and Dicotyledons.* By C. E. BESSEY.
16. *Notes on the Pine-inhabiting Species of Peridermium.* By L. M. UNDERWOOD and F. S. EARLE.
17. *Reaction of Leaves to continual Rain-fall.* By D. T. MACDOUGAL.
18. *Studies in nuclear Phenomena, and the Development of the Ascospores in certain Pyrenomycetes.* By MARY A. NICHOLS.
19. *The Stigma and Pollen of Arisaema.* By W. W. ROWLEE.
20. *Notes on the Genus Amelanchier.* By N. L. BRITTON.
21. *Remarks on the northern Species of Vitis.* By L. H. BAILEY. (By title.)
22. *On the Formation and Distribution of abnormal Resin-ducts in Conifers.* By ALEX. P. ANDERSON.
23. *The Development of the Cystocarp of Griffithsia Bornetiana.* By ARMA A. SMITH.
24. *Notes on the Allies of the sessile Trillium.* By L. M. UNDERWOOD.
25. *On an apparently undescribed Cassia from Mississippi.* By C. L. POLLARD.
26. *A bacterial Disease of the Squash-bug, Anasa tristis.* By B. M. DUGGAR.
27. *What is the Bark?* By C. R. BARNES.
28. *Embryo-sac Structures.* By J. M. COULTER.
29. *Some Cyperaceae new to North America, with Remarks on other Species.* By N. L. BRITTON.
30. *Grasses of Iowa.* By L. H. PAMMEL.
31. *Ceres-Pulver: Jensen's new Fungicide for the Treatment of Smut.* By W. A. KELLERMAN.
32. *On the Cardamines of the C. hirsuta Group.* By N. L. BRITTON.
33. *The Relation between the Genera Polygonella and Thysanella, as shown by a hitherto unobserved Character.* By JOHN K. SMALL.
34. *An apparently undescribed Species of Prunus from Connecticut.* By JOHN K. SMALL.
35. *The Flora of the Summits of King's Mountain and Crowder's Mountain, North Carolina.* By JOHN K. SMALL.

36. *Parthenogenesis in Thalictrum Fendleri.* By DAVID F. DAY.
37. *A Discussion of the Order Pezizineae of Schröter.* By ELIAS J. DURAND.
38. *What should constitute a Type Specimen.* By S. M. TRACY.
39. *Rheotropism and the Relation of Response to Stimulus.* By F. C. NEWCOMBE.
40. *Some Adaptations of Shore-plants to Respiration.* By HERMANN VON SCHRENK.
41. *The Mechanism of Curvature in Tendrils.* By D. T. MACDOUGAL.
42. *Island Vegetation at the Lake of the Woods.* By CONWAY MACMILLAN.
43. *Sporophyll-transformation in dimorphic Ferns.* By GEO. F. ATKINSON.
44. *A Contribution to our Knowledge of the Relation between Growth and Turgor.* By E. B. COPELAND.

The meeting was pronounced the most successful hitherto held by the Section of Botany, and this was celebrated by an informal dinner held on Thursday evening, August 27th, which was enjoyed by forty members, Messrs. Hollick and MacDougal acting as toast masters in so felicitous a manner that they were unanimously requested to repeat the experiment at the next meeting.

On Friday, August 28th, the members of the Section were the guests of the Buffalo Naturalists' Field Club at Point Abino, Ontario, and enjoyed a beautiful day, and the study of a very interesting flora.

Officers for the next meeting, to be held at Detroit, Mich., beginning August 9th, 1896, are Prof. Geo. F. Atkinson, President, and Prof. F. C. Newcombe, Secretary.

Proceedings of the Botanical Club, A. A. A. S., Buffalo Meeting, August 25–29, 1896.

TUESDAY, AUGUST 25TH. MORNING.

In the absence of Mr. Coville, President, and Prof. MacMillan, Vice-President, Prof. Kellerman was elected President *pro tem.* Mr. Cowell, Secretary, submitted the registration book for signatures of members present and distributed badges.

Prof. Kellerman distributed copies of a map of Ohio, showing the distribution in the southern counties of that state of *Phoradendron flavescens*, *Bignonia crucigera*, which covers the fences in some places, and *Polypodium polypodioides*. Prof. Coulter remarked on the distribution of the *Phoradendron* in the lower Wabash region of Indiana and Illinois. Prof. Tracy stated that it is abundant in southern Illinois, and Prof. MacDougal recorded its occurrence at points in southern Indiana.

Prof. Kellerman remarked that the Canada Thistle, *Carduus arvensis* does not spread in southern Ohio. Prof. Lazenby stated that seeds of the plant are not formed in the region.

Prof. L. R. Jones described a method of distributing pure cultures of fungi. Owing to mixed growth of several species of fungi upon the same substratum, it is often difficult to obtain an uncontaminated growth for distribution in exsiccati. The growth and distribution of pure cultures easily obviates this difficulty. These pure cultures can readily be made in quantity and in convenient form for distribution by placing paraffined paper in the bottom of large culture dishes; the agar, or other nutrient medium, is then poured upon this, and seeded with spores from a pure culture. When colonies have reached sufficient development, the whole is dried down, the paper bearing the fungus is removed from the dish and cut up for distribution. Prof. Jones suggested that the method might be applied to the distribution of bacterial cultures. Concerning this, Prof. Russell stated that the method could not be used for the propagation of such cultures, as the bacteria, especially the non-sporogenous forms, die out so easily when subjected to desiccation. It might be of service, however, in preserving the appearance of colonies. Mr. Duggar inquired if

Prof. Jones had tried distributing cultures on mica. Prof. Jones replied that the paraffined paper was cheaper.

Mrs. Britton reported the occurrence of the moss *Tetraplodon bryoides* in large quantities on the timbers soaked with drainage from the stables on the summit of Mount Washington, N. H., and distributed specimens collected there in July, 1895, by Mr. Edwin Faxon, Dr. Geo. G. Kennedy and Mr. E. F. Williams; it had previously been found only in small patches on this mountain. She also remarked on the distribution of the species in North America.

Judge Day remarked as follows on *Iris:* It seems to be a character of the rhizomatous species of *Iris*, when forming flowers for the following season, to produce at the extremity of the rhizome three buds, side by side, of which the two lateral ones are merely vegetative and the central one, alone, productive of flowers. I have noticed this character in *Iris versicolor, Virginica, verna, cristata* and *cuprea*, of North America, and *Kaempferi, pumila, Siberica, Pseud-acorus, sambucina, Florentina* and *Germanica*, so-called, of the Old World. I have failed to find it in any of the bulbous *Irises*, or in any other genus of the Iridaceae, and think the observation has not been heretofore recorded.

Prof. Bessey remarked on the distribution of the bear-berry, *Arctostaphylos Uva-ursi*, in Nebraska, stating that it is known to occur with *Pinus pondorosa* in two widely separated stations near the 100th meridian, one of these being in a cañon in the central county (Custer) and the other a cañon on the south side of the Republican River, near the south border of the state. Judge Day said that in the Buffalo region it follows the Niagara River, but does not enter the gorge. Prof. Bessey remarked that ericaceous shrubs will not grow on the plains.

Tuesday, August 25th. Afternoon.

Prof. Newcombe described an improvement to the paraffine-bath, consisting of a device for adjusting the receptacles of the bath at various heights so as to secure different temperatures in the receptacles, while the temperature of the bath remains constant. This adjustment can only be made in baths in which there are closely fitting, removable receptacles, sitting into pockets. Such a

bath can easily be made to order, and to the bottom of the receptacle brass strap-springs can be so riveted as to sustain the receptacle at any height by pressure against the side of the pocket.

Prof. Rowlee presented the following notes on the branching of oaks:

I. Our species of trees differ very widely in their method of branching. All, however, with the possible exception of the cottonwood, agree in that the branches are produced from the buds nearest the terminal bud of a season's growth. No group has this peculiarity in so marked a degree, however, as the oaks. In them the internodes near the terminal bud are shortened and the branches appear close together. The branches appear in periods upon a main branch, each branch-bearing region being in the immediate vicinity of a season's terminal bud. This peculiar method of branching contributes toward the rigid character of an oak tree. It is primarily due to the position of the branches and the short nodes in that region.

II. Normally oaks make a definite seasonal growth terminated by winter bud. A tree (*Quercus macrocarpa*) in the writer's yard has departed from this mode of growth during the present season in a very decided manner. Early in the season, in May and early June, the tree in question developed normal annual shoots, each terminated by a winter bud. In the early days of July these winter buds swelled and developed into leafy shoots duplicating the growth already made. There was more contrast between the first and last leaves of the last growth and the leaves were very light colored. The question naturally arose whether the double seasonal growth in length was accompanied by double cambial growth; sections show that up to the time of the investigation (August) but a single ring had been formed, that is, the cambial growth had been continuous.

[In the discussion which followed this paper it was stated that fruit trees frequently made a double seasonal growth in one year, and that autumnal flowering of fruit trees was accompanied by this phenomenon.]

III. Specimens of white oak branches were exhibited illustrating an unusual degree of variation in the branches of an individual tree. This tree is isolated from dwellings and from other

trees and stands in a field east of Ithaca. The main part of the tree is normal, a single branch on the east side and low on the tree has much smaller leaves and acorns. The contrast between this branch and the rest of the tree is so marked as to be seen at considerable distance, and was well shown in the branches exhibited.

WEDNESDAY, AUGUST 26TH. MORNING.

Prof. L. R. Jones presented some notes on potato-leaf blights, stating that *Phytophthora infestans* D. By. is common only in northern New England, northern New York and Canada. The so-called "Early Blight," attributed to the parasitism of the fungus *Macrosporium Solani* E. & M., is generally due not to the attacks of any fungus, but to arsenical poisoning, or to drought or other unfavorable conditions surrounding the plant. On such dying potato leaves there occurs very generally a saprophytic fungus closely resembling *Macrosporium Solani*, but which in cultures develops quite differently. This fungus is distinctly an *Alternaria*, ten or fifteen spores often being produced in a single chain. *Macrosporium Tomato* Cooke, develops exactly similar chains of spores in culture, and it seems probable that the *Alternaria* from the potato leaf is the same as the tomato *Macrosporium*, but which should properly be called *Alternaria Tomato*. Under especially favorable conditions *Macrosporium Solani* has also developed spores in chains, and hence should be known as *Alternaria Solani*.

Dr. Russell described a method of hindering the condensation of water in Petri plates where agar is used as a medium. It was simply to enclose culture dish in an ordinary porcelain bowl and cover same with a smaller inverted one. This maintains an equal temperature, both inside and outside of culture, thereby preventing the accumulation of condensed water on under-surface of cover.

Dr. Bessey gave an outline of the flora of Colorado Springs, stating that there was here a sudden transition between the floras of the plains and the mountains. In the vicinity of the town, at an elevation above the sea of about 6,000 feet, the plants are nearly the same as those about Lincoln, Nebr., which is situated near the eastern side of the plains. He explained that radiating

from Pike's Peak, down to the plains, there are numerous deep dark cañons, whose vegetation was very different from that of the plains or the mountains proper. The cañon flora, however, has been greatly modified by forest fires, causing the opening up and drying out of the gorges, as in the case of South Cheyenne Cañon, and by the vandalism of tourists who have ruthlessly destroyed ferns, columbines, *Calochortus*, and other showy plants. The flora of elevations from 10,000 to 13,000 feet is scant and low on the open dry ridges and summits; in the mountain meadows, grasses, sedges and clovers abound; the mountain swamps are overgrown with *Potentilla fruticosa*, but no sphagna were observed. Prof. L. R. Jones remarked that *Potentilla fruticosa* took possession of old fields and pastures in Vermont, becoming a weed.

Mr. E. J. Durand reported a new station for *Epipactis viridiflora;* this plant appeared with some ferns on a lawn in the village of Canandaigua, N. Y., which had been transplanted from some point in the vicinity. Judge Day remarked that attempts to cultivate it at Buffalo had not succeeded. Mrs. Britton said that a similar experience had been had with *Arisaema Dracontium* on Staten Island, which came up in a fern bed, while no other station for the species is known on the island.

Mr. Pollard, Assistant Curator of the U. S. National Museum, explained briefly the terms of transfer which has been effected of the National Herbarium from the control of the Department of Agriculture to that of the Smithsonian Institution. The work is now carried on by three assistant curators under the general supervision of Mr. Frederick V. Coville, Honorary Curator; and Congress has this year appropriated the sum of $10,000 for the care and maintenance of the herbarium.

Mrs. Britton made the following remarks on the rediscovery of *Schizaea pusilla* in Newfoundland: The Rev. A. C. Waghorne has recently sent me two small tufts of this little fern which he collected last year about 70 miles from Bay of Islands, Newfoundland; "in bogs, borders of ponds, the quarry N. W. of the railway." The specimens are small like those I collected in Nova Scotia, but they have an abundance of fertile fronds, which are quite mature. It will be remembered that this is the fern that was found in the herbarium of De La Pylaie, from Newfoundland,

but that it was for a long time doubted whether it could possibly have been found there, Dr. Gray and others supposing that the locality must have been a mistake, and that the specimens must have come from New Jersey. This discovery completely settles that question, and makes it evident that it is only those who know what to look for will find this fern, and that it will be found in intermediate stations between Nova Scotia and New Jersey, along the coast of New England, possibly on Long Island.

Mr. Karl M. Weigand presented the following notes on the genus *Boschniakia*. Specimens of *Boschniakia* recently received from Tacoma were found not to agree at all well with the existing characterization of this genus as given in the Synoptical Flora. This led to an examination of all the herbarium material at hand, with the following results: It was found, in the first place, that instead of being "ebracteolate" all members of the *strobilacea* group have some or all of the flowers subtended by two subulate bractlets, and, instead of "calyx truncate behind and with three teeth in front," two teeth only were found in the above mentioned group and these were always lateral. The subdivisions found in the Synoptical Flora are also unjustifiable. In the *strobilacea* group the calyx-teeth are not longer than the tube, and not always subulate; the scales are not always obtuse, and the placentae in one case were found to be three instead of four. Specimens of *B. glabra*, the species on which the genus was founded, on the other hand, agree exactly both with the generic description and with the sections, and it seems, therefore, as if the characterization had not been properly changed in the addition of subsequent species. *B. Hookeri* is probably not distinct from *B. strobilacea*, as Dr. Gray suggested in Proc. Amer. Acad. in 1887. Although not a sufficiently large number of specimens have so far been examined to warrant definite conclusions, it seems certain that this genus is in need of a thorough revision, and it is thought desirable to call attention to the above noted discrepancies for the purpose of drawing criticism from others.

Wednesday, August 26th. Afternoon.

The committee on nomenclature submitted the following report:

To the Botanical Club, A. A. A. S.:

Your committee on nomenclature, which was requested at the Springfield meeting to prepare a report, would respectfully submit the following preamble and resolutions:

WHEREAS, A large number of requests for a list of all North American Pteridophyta and Spermatophyta has been received, and publication for such a list, when prepared, has been informally offered by the Assistant Secretary of the Smithsonian Institution;

Resolved, That the committee be and hereby is authorized to prepare for publication a list of Pteridophyta and Spermatophyta occurring in the United States and the British possessions of North America.

Resolved, That the committee be and hereby is authorized to prepare and publish a supplement to the "List of Pteridophyta and Spermatophyta of Northeastern North America," such supplement to contain additions and published corrections to the List. Such publication has been promised by the Editor of the Torrey Botanical Club.

Resolved, That the committee be and hereby is authorized to prepare a fuller statement of the rules adopted at the Rochester and Madison meetings, with examples illustrating their operation, and submit it to the Club at a subsequent meeting, for publication in the proposed List of North American Pteridophyta and Spermatophyta.

For the Committee,

N. L. BRITTON, *Chairman.*

The report was discussed by Prof. Coulter and Prof. Bessey, was approved and the resolutions unanimously adopted.

Mr. Pollard, on behalf of Dr. F. H. Knowlton and others, submitted a resolution calling for the appointment of a committee to consider and report on the desirability of the Club publishing a journal. After considerable discussion, it was laid on the table.

Prof. Barnes discussed the relative merits of the terms photosyntax and photosynthesis, maintaining that the first was the more desirable. Prof. MacDougal considered that both terms were temporary, but inclined to the use of the second.

Prof. Bessey remarked on the distribution of *Pinus ponderosa* in Nebraska, which to-day forms extensive forests on the summits of Pine Ridge (alt. 4,000 to 5,000 feet), in northwestern Nebraska, and extends eastward along the bluffs of the Niobrara River to within twenty-five or thirty miles of its mouth. It extends eastward along the North Platte River and Lodge Pole Creek, nearly

or quite to Deuel County. It occurs, also, in isolated cañons in the central counties (in the Loup River Valley) and thence fifty or sixty miles eastward. Recently some remains of a considerable grove of pines was discovered along the bluffs of the Republican River, in Franklin County, about fifty miles east of the 100th meridian.

Mr. Cowell exhibited specimens of hybrid and double-flowered sunflowers, *Helianthus decapetalus* × *H. petiolaris* and *H. lenticularis*.

THURSDAY, AUGUST 26TH. MORNING.

Prof. Bessey remarked on the cañon flora of the plains. On the Great Plains there are two nearly distinct floras, viz: (*a*) that of the general surface, which, as we pass westward, is more and more like that of the arid regions, and (*b*) that of the river valleys and cañons, in which are found trees, shrubs and herbs which have invaded this dry region from the east and west. The line of demarkation between the cañon flora and that of the general surface is often very sharp, the one giving way to the other within the space of a yard or less.

Dr. E. B. Copeland discussed turgor-variations in the mosses. He stated that turgor is higher in the mosses than in most other plants, and exceedingly variable. Tests were made on various species, especially *Mnium cuspidatum* and *Funaria hygrometrica* at temperatures varying from 0°–34° Centigrade, the turgor being determined by plasmolysis in solutions of potassium nitrate. From near zero up to 20°C. there was a decided decrease of turgor with increase of heat. This variation is due to chemical changes in loco, but seems to be unaccompanied by any change in the starch or sugar present. In *Mnium*, however, it is dependent on the presence of not very remote products of assimilation. This adjustment of the concentration of the cell sap is of manifest advantage in resisting variations of temperature.

Dr. A. P. Anderson described a simple apparatus for spraying plants, consisting of two tubes at right angles to each other, similar to the one used by artists for spraying crayon drawings.

Mr. E. J. Durand described the structure of pseudo-parenchyma in the higher fungi. In most of the higher fungi there is a tissue

which much resembles the parenchymatous or fundamental tissue of the higher plants. Owing, however, to its hyphal origin, it is usually termed pseudo-parenchyma. The transition from interwoven hyphae to this tissue may be well seen in the stromata of *Tubercularia*, especially if the perithecial forms be present. The hyphae become much septate and the cells swollen and coalesced, forming a tissue of rounded cells. In the *Pezizas* and *Discinas*, also, we find the transition nicely shown. In these plants the cells are often large and vesiculose, but are formed by the septation and coalescence of large hyphae.

Mr. H. von Schrenk discussed the host-plants of *Comandra umbellata*. He stated that though this species generally grows on various Ericaceae, notably *Vaccinium Pennsylvanicum* and *V. corymbosum*, he had found it on *Potentilla*, *Solidago* and *Phleum pratense*. He had found that there is no connection between the vascular systems of the parasite and the host-plant in *Phleum*, and had also cultivated the *Comandra* at St. Louis, independently of any host-plant, the plants growing to a height of several inches. He had collected *C. pallida* in Newfoundland, growing on *Vaccinium* and *Solidago*. Dr. Bessey stated that both *C. pallida* and *C. umbellata* occur in Nebraska at least 1,000 miles from any ericaceous plant. Prof. Coulter reported that he had satisfied himself that in the vicinity of Chicago *C. umbellata* grew unattached to any host.

Prof. MacMillan spoke on "The Function of the submerged Leaves of *Salvinia natans*." These hair-like leaves have been supposed to function as absorbing root-hairs, but he had observed that the rigid tips of these organs serve to prevent small aquatic animals from approaching the sporocarps, which they guard; he also stated that they project at right angles to the stem and thus serve as a counterpoise against the wind. Dr. B. B. Davis said that he had observed them entangled with humus and slime.

Prof. MacMillan remarked on "Nuclear Budding in *Cypripedium*." He stated that in *C. Reginae*, *C. acaule* and *C. hirsutum* the nuclei of the cells at the base of the hairs divided by an interesting and singular method, which differs from both methods known as phragmentation and karyokinesis, but was evidently referable to the former.

Prof. MacMillan also remarked on some unusual adaptations of conifers to wind-swept stations, stating that he had seen the white pine 40 feet high, with a small slender top and short branches, while at the base long branches had developed, lying prostrate on the rocks, having acquired a juniper-like habit; he had noticed that this habit was most frequently taken on when the main trunk was broken. Prof. Bessey recorded the same habit in Engelmann's Spruce, and Dr. Copeland recalled the well-known case of the Monterey Cypress.

Miss Florence Beckwith reported *Ononis repens* and *Plantago aristata* as additions to the flora of Monroe county, N. Y.

THURSDAY, AUGUST 26TH. AFTERNOON.

Officers for the next meeting were elected as follows:

President, Prof. S. M. Tracy.

Vice-President, Prof. L. R. Jones.

Secretary, Prof. E. S. Burgess.

Miss Edna Porter illustrated the pollination of *Epipactis viridiflora* by a model, stating that she had found the visiting insect to be a wasp, agreeing with Darwin's observations on the English species.

Dr. E. B. Copeland spoke on "The Lowest Limit of Turgor."

Nearly all of the material causing the turgor of normal stems, leaves and roots is unavailable as food, so that starvation can reduce the turgor but slightly. Thus it is seldom, if ever, possible to reduce this material by etiolation below the osmotic equivalent of 1.5% KNO_3. Where food is stored in solution it is of course represented in the turgor, but even in such organs there is usually a considerable unused, presumably non-nutrient, residue until death.

Dr. Emily L. Gregory presented the following "Notes on the Classification of Lichens:"

In many of the modern text-books of systematic botany the three groups, fungi, algae and lichens are reduced to two, the lichens being placed with the fungi. It is evident that this arrangement is based upon the notion that the lichen is composed of a fungus and alga living together in the characters of parasite and host. It is the fungus which determines the form and de-

velops the spores; therefore those lichens whose fruiting is the same as the Ascomycetes are placed as a subdivision of this class, and the remaining forms, which follow the Basidiomycetes in their method of spore-formation, are classed with this group of fungi.

Within the past few years there has been a strong reaction against this method of classification on the ground that, by virtue of this long-continued parasitism, the lichens have attained fixed characters of their own, differing from those of both fungi and algae. Prof. Reinke, of Kiel, is one of the leading advocates of this old method of classification, namely, making the lichens an independent group coördinate with the fungi and algae. He has written an extensive paper on the subject, which is published in Pringsheim's Jahrbücher, volumes 26, 28 and 29. A careless or even hasty perusal of this article is apt to lead one to the conclusion that the author's views are radically opposed to those of Schwendener, who is generally known as the author of the theory of the dual nature of the lichens. It is probably owing to this fact that a rumor has obtained circulation among some of our botanists to the effect that the modern scientists are discarding the Schwendener theory of the nature of the lichens.

During the present summer I had an excellent opportunity to read and discuss this paper with Prof. Schwendener and in this way to obtain his present views on the subject. For these reasons I think a brief summary of his remarks may be of interest to the members of the Club and others who are not so familiar with the literature of this subject. It may be well to state at first that there is no difference of opinion between the two botanists concerning the real nature of the lichen. Reinke speaks in several places of his complete adherence to the principal theories set forth by Schwendener in his work published in 1869, "Die Algentypen der Flechten-gonidien," but he does not approve of the methods of classification which owe their origin to the acceptance of these theories. Reinke also strongly opposes the views held by Schwendener regarding the morphology of the podetium of the genus *Cladonia*. Schwendener claims that his experiments, together with those of Krabbe and others working in his laboratory furnish conclusive evidence that the podetium is a part of the fruit-body. Morphologically it is to be considered the stem of the

organ containing the spores, and this reasoning is based principally upon the fact that the mycelium threads forming the so-called ascogon, and which terminate in the asci holding the spores, may be traced backward through the podetium or stem to the point of its insertion on the horizontal thallus below. Reinke claims with equal emphasis that the podetium is to be ranked as a thallus, that it forms no part of the fruit-body; he upholds his claim chiefly by the fact that it acts as an assimilating organ and therefore must be considered as a vegetative part of the plant and not a reproductive organ. The importance which Reinke attaches to his view of the morphology of the podetium explains perhaps the above-mentioned conclusion of some readers of the article that the two botanists are antagonistic in their views on the lichens. Their difference of opinion comes rather from a radical difference in their interpretation of morphological characteristics, and not from any real difference concerning the question at issue, viz: the place which the lichens ought to occupy in the natural system of classification.

Regarding this point, Schwendener expressly says that he has no objection to the plan proposed by Reinke of classing the lichens as a group by themselves, but also states that he does not think this plan would entirely do away with the difficulties in question. He gives as an example of these difficulties the fact that there are several species of fungi belonging to one genus, some of which live as parasites on algae, or as lichens, others are true fungi living entirely after the fashion of other plants of this group. If the lichens are to be classed as a separate group, there must be some provision made for such plants as these, for it surely would not be logical to separate such closely allied forms by putting them in different groups.

Reinke proposes not only a rearrangement by which the lichens would be restored to their original dignity of place, but also outlines a plan for classification within themselves based as nearly as possible upon what he considers phylogenetic principles. It may be noted in closing that it is a little curious and striking that this plan is founded upon the classification of Tuckerman, a botanist who attached little importance to the principles of phylogeny in his treatment of the lichens.

A paper by Prof. L. H. Pammel, "Notes on some Plants of Iowa," was read by title.

Prof. Coulter discussed the use of the terms close-fertilization and cross-fertilization.

A paper by Mr. R. S. Williams, "A List of the Mosses of northern Montana," was read by title. Mrs. Britton stated that sets of these mosses were in preparation.

Prof. Kellerman described a method of card-indexing a state flora, using for each species a card on which was printed a map of the state showing counties. He had used this in Kansas and in Ohio. Prof. Tracy said he had successfully applied it to Mississippi.

New and noteworthy Species of Saxifraga.

By John K. Small.

Saxifraga occidentalis S. Wats. Proc. Am. Acad. 23: 264. 1888.

This species was founded on plants collected on Vancouver Island, by Prof. Macoun. It is a beautiful and distinct species averaging one decimeter in height, with a purple hue which extends even to the petals and filaments; it also possesses an abundance of red or reddish tomentum on the lower surface of the finely crenate leaves. This form is not as widely distributed as indicated by Dr. Watson, when he states "the specific name is given to the species as the western correlative of the common eastern *S. Virginiensis*," nor is it the western correlative of the latter species, *Saxifraga Californica*, proposed in the following year holding that place. *Saxifraga occidentalis* is apparently confined to Vancouver Island and the mainland in the immediate vicinity.

Saxifraga Virginiensis Michx. Fl. Bor. Am. 1: 269. 1803.

Represents one of the most variable and perplexing species of the genus *Saxifraga*, but notwithstanding its variability in habit, size and flowers, there are two characters which serve to separate it from its relatives in western North America, namely, the triangular triangular-ovate or rarely almost lanceolate acute or acutish calyx-segments, and the narrowly elliptic or elliptic-spatulate obtuse or acute (rarely if ever notched) petals.

While collecting in the cañon below the Falls of the Yadkin river in North Carolina last April, I found unusually well developed plants of *Saxifraga Virginiensis* ranging from four to five decimeters in height, but more remarkable was the great quantity of small bulblets produced by the subterranean portions of the plants, and also the numerous offsets. The same features were noticed in specimens gathered on Dunn's mountain in the same state.

SAXIFRAGA CALIFORNICA Greene, Pittonia, 1: 286. 1889.

In the light of recent discoveries, Prof. Greene has not pointed out any reliable distinguishing characters in discussing the relations between *Saxifraga Californica* and *S. Virginiensis*. The two species are closely related in habit, and the one is about as variable as the other. Prof. Greene lays much stress on the occurrence of small bulblets in *Saxifraga Californica*, but we now know that *S. Virginiensis* also possesses this character. After examining many specimens for the purpose of finding some diagnostic characters in the two closely related plants, I find that the flower furnishes the best. Besides the reflexed or erect calyx-segments, these organs in *Saxifraga Californica* are ovate or oblong-ovate and obtuse, while those of *S. Virginiensis* are triangular, triangular-ovate, or rarely nearly lanceolate, and acute or acutish. The petals furnish another character; those of the western plant are broadly oval or suborbicular, some or all notched at the apex, while their lateral nerves vanish in the blade; in the eastern plant they are narrowly elliptic or elliptic-spatulate, not notched at the apex, and the lateral nerves converge to the mid-nerve at the apex.

SAXIFRAGA FRAGOSA Suksdorf n. sp.

Perennial by an ascending or horizontal rootstock, scapose slender, pale-green, rough glandular-pilose with rigid hairs. Leaves basal, leathery, the blades ovate or oblong-ovate, 1.5–4 cm. long, usually exceeding the petioles, glabrate, obtuse, entire or undulately toothed, abruptly narrowed or truncate at the base, decurrent on the winged petiole, which is slightly dilated at the base; scapes erect or assurgent, 2–3 dm. tall, solitary, paniculately or somewhat corymbosely branched at the top, the branches ascending or nearly erect, subtended by lanceolate or spatulate bracts; flowers white, 5–6 mm. broad, in many-flowered cymules; calyx broadly campanulate, the tube 2.5 mm. broad, adnate to the

ovary, the segments triangular or triangular-ovate, obtuse, 3-nerved, longer than the tube; petals obovate, obtuse or notched at the apex, 2.5 mm. long, strongly 3-nerved, the lateral nerves arising below the middle and converging toward the apex; filaments subulate, shorter than the petals; carpels of the ovary flat and surrounded by a disk; follicles globose-ovoid, 3.5 mm. long, distinct, tipped by short diverging styles; seeds obovoid, more or less pointed at both ends.

Wet rocks near the Columbia river, W. Klickitat County, Washington. Collected by W. N. Suksdorf. (no. 1727.)

The specimens on which this species is founded were collected in March and May, 1892, and distributed later with the manuscript name which I have taken up. It was collected also in Oregon, by Mr. Thomas Howell in May, 1895, "on wet slopes, Gladstone" (no. 192).

The species is related to *Saxifraga Californica*, but differs in its more rigid habit, rough and stiff pubescence, the narrow thyrsoid panicle or corymb and the triangular or triangular-ovate calyx-segments.

Saxifraga Tennesseensis n. sp.

Saxifraga Grayana Kearney, Bull. Torr. Club, **21**: 262. 1894. Not Britton, 1894.

Perennial by a short erect or ascending rootstock, scapose, glandular-pilose, bright green. Leaves basal, ovate or sometimes suborbicular, the blade 2–6 cm. long, obtuse or rounded at the apex, but usually terminated by a tooth, coarsely crenate-dentate, abruptly narrowed at the base, the petiole winged, longer or shorter than the blade; scapes erect or assurgent, 1–2.5 dm. tall; branches of the panicle subtended by linear or spatulate bracts; cymules open; flowers white, 8–9 mm. broad; calyx flattish, 5 mm. broad, its tube adherent to the ovary, its segments triangular-ovate, 1–1.5 mm. long, acute, spreading, longer than the tube; petals lanceolate, 3.5–4 mm. long, obtuse or slightly notched at the apex, sessile or nearly so, with two lateral nerves which arise below the middle and converge at the apex, the lateral nerves often giving off short secondary branches; filaments subulate, somewhat longer than the calyx-segments, mature fruit not seen.

Rocky bluffs of the Tennessee River about Knoxville. Altitude about 270 meters.

Saxifraga Tennesseensis was apparently first collected by Prof. A. Ruth, of Knoxville, Tennessee, but first brought to notice by

Mr. T. H. Kearney, who erroneously referred it to *Saxifraga Grayana*, a member of the subgenus *Hydactia*. The species really belongs to the subgenus *Micranthes* and is a close relative of the common *Saxifraga Virginiensis*. The primary character to debar it from relationship with *S. Grayana* is its subulate filaments; the calyx-segments, petals and follicles are also different from those of that species. The pubescence in *S. Tennesseensis* is inclined to be tomentose and tawny and is much more abundant than in *S. Virginiensis*. Besides its general habit, it can be readily distinguished by its lanceolate petals, which are notched at the apex and strongly marked with two yellow spots near the base.

SAXIFRAGA CLAYTONIAEFOLIA Canby n. sp.

Perennial by a short horizontal rootstock, slender, glandular-pilose above, glabrate below. Leaves fleshy, orbicular-elliptic, more or less oblique, 6-10 cm. long, glabrate, obtuse, entire, undulate, palmately six-eight-nerved, narrowed into a winged ribbed petiole which is as long as the blade or longer; scape erect or assurgent, 2-3 dm. tall, glabrate near the base, branched above; infloresence thyrsoid-corymbose, its branches subtended by small linear or linear-oblong bracts; flowers white, 4 mm. broad, each subtended by a small bractlet; calyx flattish, 2 mm. high, its segments spreading and recurved, thin, oblong, acute, 3-nerved, longer than the tube; petals spatulate or obovate-spatulate, 2 mm. long, slightly emarginate or minutely apiculate, gradually narrowed into a claw, marked with a stout midnerve which gives off two lateral nerves about the middle; filaments subulate, shorter than the petals, incurved at the summit; follicles (each) ovoid, 3 mm. long, the short stout styles spreading at an angle of 120° or more; seeds irregularly oblong, .7 mm. long, reddish, smooth, or very faintly striate.

Damp crevices of rocks, The Dalles, Oregon. Collected by Frank Tweedy, May, 1883.

I have taken up a specific name attached to a specimen, by Mr. Canby, preserved in the Canby Herbarium, now at the College of Pharmacy, New York. The form is without doubt an excellent species, differing from the related *Saxifraga integrifolia* by its leaves, which closely resemble those of a broad-leaved *Claytonia*, its flat calyx-tube, its oblong calyx-segments and its spatulate or obovate-spatulate petals, which are only 3-nerved and either notched or apiculate at the apex.

SAXIFRAGA NIDIFICA Greene, Erythea, 1: 222. 1893.

This rare *Saxifraga* has lately been sent me by Mr. E. P. Sheldon. The specimens are from Spokane, Washington, altitude 1,000–2,000 feet and were collected by J. H. Sandberg and J. B. Leiberg in May, 1893. *Saxifraga nivalis* (no. 1819) of Mr. Coville's Death Valley report, apparently belongs here, as does also Torrey's 155, collected in the Yosemite Valley and Mountains, California, in 1865.

SAXIFRAGA PLANTAGINEA n. sp.

Perennial by a thick rootstock, stout, scapose, glandular-pilose; leaves elliptic or elliptic-spatulate, 6–10 cm. long, obtuse, undulate or distantly and shallowly toothed, leathery, ciliate, 5-7-ribbed, narrowed into a winged petiole, which is usually much shorter than the blade; scape erect, 2–4 dm. tall, sparingly branched near the top, the branches subtended by elliptic bracts; flowers greenish, in dense cymules; calyx flat, its segments ovate, 3.5 mm. long, obtuse, 3-nerved, longer than the tube; petals suborbicular-oblong or some inclined to be broadly spatulate, 2–2.5 mm. long, greenish, shorter than the calyx-segments, obtuse, marked with a midnerve and several branches, narrowed into a broad claw; filaments converging, subulate, shorter than the petals; ovaries immersed in a lobed disk; fruit not seen.

Spokane, Washington, at 600–1,000 meters altitude; collected by J. B. Leiberg and J. H. Sandberg, in May, 1893. Communicated by Mr. E. P. Sheldon.

A fine species with leaves strongly resembling those of some of the broader-leaved *Plantagos*. The plant is very different from anything heretofore known in the genus *Saxifraga*. It is related to *S. integrifolia*. The broad greenish petals, which are exceeded by the calyx, serve to separate the species from all its relatives.

SAXIFRAGA SIERRAE (Coville).

Saxifraga integrifolia Sierrae Coville, Proc. Biol. Soc. Wash. 7: 78. 1892.

Saxifraga Oregana Howell, Erythea, 3: 34. 1895.

As Mr. Howell points out, *Saxifraga integrifolia* has been a composite species. Mr. Coville dwells on the differences in the leaves of *Saxifraga Sierrae* and *S. integrifolia;* these differences are much more marked in specimens collected later by Mr. Howell,

in Oregon. But in addition to these leaf-characters, the flower furnishes good points of distinction.

The calyx-segments in *Saxifraga Sierrae* are suborbicular and broader than long (except in Mr. Howell's specimens, where the whole vegetative and floral systems are abnormally elongated), the calyx-segments in *S. integrifolia* are ovate and longer than broad; the petals are ovate or broadly oblong and retuse at the apex, as opposed to the obovate petals of *S. integrifolia* with their rounded apices.

SAXIFRAGA REFLEXA Hook. Fl. Bor. Am. 1: 249. pl. 85. 1833.

Several unsuccessful attempts to reëstablish this rare species have been made. Taking Hooker's excellent plate as a basis, and this is all we have to go on besides his description, I find that the following numbers from the collections of the Northern Transcontinental Survey, distributed as *Saxifraga nivalis*, are *S. reflexa*: 51a Scribner, 740 and 741 Tweedy, 757 Brandegee and 111 Canby. These are the only representatives of *S. reflexa* I have seen and are all in the Canby herbarium.

SAXIFRAGA MONTANENSIS n. sp.

Scapose, perennial by a stout horizontal or ascending rootstock, coarse, stout, glandular-pilose. Leaves basal, ovate or lanceolate, .5–1.5 cm. long, leathery, obtuse or acute, serrate-dentate, nearly sessile or apparently sessile on account of the broadly winged and dilated petiole; scapes solitary, erect, 3–6 dm. tall, stout (6–11 mm. in diameter), paniculately branched above, the branches usually shorter than the internodes; flowers greenish, almost 11 mm. broad, in dense glomerate cymules; calyx turbinate-campanulate, 5-parted to below the middle, its tube adnate to the ovary, its segments triangular-ovate, obtuse, at length deflexed; petals 5, greenish, lanceolate or linear, often slightly oblique, 3.5 mm. long, obtuse, 3-nerved, the lateral nerves arising below the middle, running close to the mid-nerve; filaments subulate, thrice shorter than the petals; fruit not seen.

Southwestern Montana, in bogs at 1,850 meters elevation. Collected by Mr. Frank Tweedy (No. 58), July, 1888. Also found by Prof. F. D. Kelsey at Millan, Montana. The proposed species stands between *Saxifraga Sierrae* and *S. Pennsylvanica*. It differs from the former in its harsh pubescence which gives it a dull green color and in its comparatively small greenish flowers. From

the latter it may be distinguished by its habit, its more or less turbinate calyx-tube and the calyx-segments, which are triangular-ovate and about as long as the tube. In *Saxifraga Pennsylvanica* the calyx-tube is campanulate, the segments ovate-lanceolate or ovate and twice as long as the tube. The petals of the new species are oblanceolate or nearly linear, while those of its eastern relative are lanceolate or linear-lanceolate.

SAXIFRAGA NOOTKANA Moçin; Engler, Monog. Sax. 135. 1872.

Saxifraga Stellaris var. *Brunnoniana* Bong. Veg. Sitcha, 140. 1831. Not *S. Brunnoniana* Wall.

Saxifraga leucanthemifolia var. *Brunnoniana* Engler, Monog. Sax. 135. 1872.

Saxifraga Bongardi Presl; Engler, Monog. Sax. 135. 1872.

This is one of our northwestern forms that has usually been included under *Saxifraga leucanthemifolia* (*S. Michauxii*). It is more closely related however to the old world *S. stellaris*, but is nearer the Alleghenian *S. Michauxii* than any of the several west-American species of the subgenus *Arabidia* that have so persistently been referred to the Alleghanian form.

SAXIFRAGA FERRUGINEA Graham, Edinb. Philos. Journ. : 349. 1829.

This is another *Arabidia* of the Northwest. It is apparently very rare and has usually been referred to a variety of *S. Michauxii* (*S. leucanthemifolia* Michx.) or included in that species. Some of its distinguishing marks are the low stunted stature, the reddish-brown tomentum and the short few-flowered one-sided corymb. The only recent collection appears to be that of Dr. G. M. Dawson, made on the Queen Charlotte Islands in July, 1878.

SAXIFRAGA NUTTALLII.

Saxifraga elegans Nutt.; T. & G. Fl. N. A. 1: 573. 1840. Not Sternb. 1832.

Little was known of this beautiful and most delicate Saxifrage until it was rediscovered in Oregon in 1871 by E. Hall (156). There is a good and ample specimen of Nuttall's type in the Columbia University Herbarium. Mr. Howell has lately found it at three localities in Oregon.

The Stigmas and Pollen of Arisaema.*

By W. W. Rowlee.

(Plates 272, 273.)

The native Araceae fall into two natural groups. One group, which Dr. Gray in his Manual calls "the genuine Araceae," consists of the genera *Arisaema*, *Peltandra* and *Calla*. The flowers in this group have no floral envelopes and are almost always monoecious or dioecious by the suppression of either the stamens or pistil.

The other group consists of *Spathyema*, *Orontium* and *Acorus*, genera composed of plants having complete and perfect flowers. This group is much more generalized in its characters than the other, and if either deserves to be called the "genuine Araceae," this, it seems to me, is the one.

So general is the belief now that the Araceae and the Lemnaceae present an illustration of specialization by reduction, it need hardly be mentioned that *Arisaema* and its congeners have departed farther from the ancestral forms than *Calla* and its congeners.

The stamens of *Arisaema* appear to stand singly upon the spadix, each stamen representing a single flower. In *A. triphyllum* this flower really consists of two stamens, the filaments of which are grown together so completely as to present the appearance of a single stamen.

The number of cells in the anther and the vascular strands in the filament reveal the fact that cohesion has taken place. The anthers are also simple in their structure. See 1, plate (I.).

While collecting material for class-work in the spring of 1895, I put a spadix of *Arisaema triphyllum* into alcohol for study. Later when sections were made it was found that although the anthers had dehisced, nevertheless the anther cavities had considerable pollen in them, and that many of these pollen grains, still remaining in the anther, had developed tubes. In some, the tubes were long, in others short, in some they had barely left the grain.

The longer ones instead of growing out in a straight path showed a great tendency to grow back upon themselves. The appearance at first led me to think that it grew in a close spiral-

* Read before Section G, A. A. A. S., Buffalo meeting, August, 1896.

like coil, but further examination showed that the tube folded back and forth upon itself in such a way as to form a double layer. This peculiar growth was due in all probability to the meager amount of moisture in the anther, the folding serving to conserve moisture most effectively. Some tubes made as many as five double folds. Apparently the folding occurred after the tube had attained considerable length.

Repeated examination of the pollen of both *Arisaema triphyllum* and *A. Dracontium* failed to afford another specimen in which germination had taken place, and it seemed scarcely probable that this precocious development would occur frequently. It may have been due to the season or the situation; so far as I can see, it in no way benefits the plant.

Warming, in his Systematic Botany, makes a group of monocotyledons which he calls the Enantioblastae, remarking that these plants ought perhaps to be amalgamated with the other orders. Although the Araceae are not included in this group, both species of *Arisaema* have truly enantioblastic ovules. The stigmas of *Arisaema* are remarkable in that the stigmatic surface not only covers the external surface of the capitate stigma, but extends down the short *open* style and forms a stigmatic surface at the summit of the cavity of the ovary, very much like the stigma on the outside of the ovary. The stigmatic hairs are club-shaped, quite long (short in the tube) and are not septate. They are closely packed together. The erect ovule reaches up to the hairs within the ovary. It remains to be seen just what the course of the pollen tube in these hairs is. It seems reasonable to suppose that the tube would enter the cavity of the ovary through the opening in the hollow style and that its entrance would be facilitated by the stigmatic hairs.

CORNELL UNIVERSITY.

Explanation of Plates.

PLATE 272.

Fig. 1. Vertical section of consolidated stamens of *Arisaema triphyllum*, showing anthers and anther-cavities, also structure of filament. (×125.)

Fig. 2. Pollen grain. Fig. 3. Pollen grain germinated. Fig. 4. Pollen grain germinated, the tube closely folded upon itself. (Figs. 2, 3 and 4, ×1400.)

PLATE 273.

Fig. 5. Vertical section of pistil showing ovules and stigma. (×350.)

Reviews.

An Illustrated Flora of the Northern United States, Canada and the British Possessions, from Newfoundland to the Parallel of the Southern Boundary of Virginia, and from the Atlantic Ocean Westward to the 102d Meridian. By Nathaniel Lord Britton, Ph. D., Emeritus Professor of Botany in Columbia University, and Director-in-Chief of the New York Botanical Garden, and Hon. Addison Brown, President of the Torrey Botanical Club. In Three Volumes. Vol. I., Ophioglossaceae to Aizoaceae; Ferns to Carpet-weed. Royal 8vo, pp. 612, New York, Charles Scribner's Sons, 1896. Price per volume, $3.00.

An entirely distinct epoch in the study of the North American flora is marked and, as to its general influence, inaugurated by the publication of this great work. Popularization, but with a distinct gain to science; a more intelligent and natural arrangement of groups; the application of broader and more natural principles in the delimitation of species; a full and careful consideration of distribution; a rational and just system of nomenclature—these are some of the progressive steps which are forcibly and clearly brought to mind as we examine the pages of our new flora. In comparing new works with old, we are often led to disparage the former because of the poorer advantages which were possessed by the authors of the latter. It is, however, quite safe to say that in no preceding work of the kind have the materials at hand been more completely utilized, nor has there been a more careful consideration of principles, or a more exhaustive study of details. Those American botanists who have prayed for more botany and less nomenclature may now give thanks! The first portion of their prayer, at least, is answered. The scope and nature of the work cannot be better stated in brief than by quoting the opening paragraph of the authors' introduction:

"The present work is the first complete Illustrated Flora published in this country. Its aim is to illustrate and describe every species, from the Ferns upward, recognized as distinct by botanists and growing wild within the area adopted, and to complete the work within such moderate limits of size and cost as shall make it accessible to the public generally, so that it may serve as an inde-

pendent handbook of our Northern Flora and as a work of general reference, or as an adjunct and supplement to the manuals of systematic botany in current use."

The introduction also informs us that about three-fourths of these species, some four thousand in number, are here figured for the first time. Vol. I contains 1425 figured species.

Not only is the conception of such a work as a practicable possibility to be credited to Judge Brown; the elaboration of the plan and the surmounting of the difficulties which have from time to time arisen have been his constant care. Above all, it is through his munificent provision of the substantial means that the accomplishment of the undertaking has been rendered possible. Much as we owe to the publishers, whose names appear upon the title-page, it must not be unknown to the public that the real publisher is the Hon. Addison Brown, nor that he undertook the publication as a labor of love, with little prospect at the time that it would ever prove other than an expensive contribution to the popularization of science. Nor is it out of place to hazard the opinion, after a study of the work, that the actual result will yet prove for the publisher a surprise upon the sunny side.

The value of illustrations thus presented need hardly be dwelt upon. Important as they are in introducing the general public to a knowledge of our plants, the value of reliable figures is appreciated by none more keenly than by the experienced botanist. Not because they are more important than some other features of the work, but because of their greater prominence, the illustrations are examined first.

The adoption of proper sizes for the cuts has required constant study and thought. To display undimmed the individuality of the plant was the first consideration, while upon the other hand, to destroy the popular character of the work by unduly enhancing the cost, was to sacrifice the principal object for which it was undertaken. Apparently the most successful result possible in this direction has been attained. When the entire plant could not be figured, it has been individually studied as to its most characteristic parts. Tall stems have frequently been included by representing them in a doubled or

folded position. In all cases of reduction, life-size drawings have been employed. The magnification of such minute parts as sporanges, akenes, seed-coats and appendages is a feature of the very highest importance, and one the educational influence of which can hardly be over-estimated. Good instances are the fruits of the *Potamogetons* and dissections of the column in Orchidaceae. The reduction is conspicuously indicated beside the general illustrations; the degree of magnification of the minuter parts is not stated, being considered unnecessary; but we regret the omission, or, at least, that it was not made clear that the same degree was used in illustrating the same organ throughout a group.

The work upon the illustrations, both drawing and engraving, is of the very highest quality, and a remarkable degree of naturalness has in most cases been attained. In many cases, as, for instance, in that of *Xyris torta*, the figures are exceedingly beautiful. Drawn usually from herbarium specimens, the figures have afterward been compared as often as possible with the living plants. To have drawn all the figures from life, would, doubtless, have still further improved the appearances, but this was obviously impossible.

Natural considerations, which have been allowed to control the entire planning of the work, are manifest in the choice of the boundaries selected for the flora. Even the announced limits are over-stepped when necessary to complete a natural region, as in the inclusion of the extra-limital portions of Nebraska. That the relations between geography and botany have been attentively studied is evidenced in more than one way. Both local catalogues and local herbaria have been thoroughly searched to determine the precise range-limits, and great care has been exercised in indicating clearly the habitats of the species. In no preceding work has the subject of range been so well elaborated. We find in this work, moreover, about the first systematic attempt to give the altitudinal distribution. So little attention has been paid by collectors to this important subject that the information here accumulated by Dr. Britton can hardly be regarded as more than a working basis, but as such its value will prove very great. Not the least valuable of the geographical features is the statement, in a general way, of the extra-territorial ranges of the species. Hav-

ing thus clearly established the ranges of the forms, they have been allowed to exercise a certain weight in deciding in difficult cases of species-limitation. So important has this subject of plant-geography come to be regarded in modern botany, that we may indulge a little natural pride in the appearance of so thorough a study of it by American authors.

It is scarcely necessary to review here the slow and laborious process by which systematic botanists since Linnaeus have worked toward the natural arrangement and sequences of plant-groups. It is sufficient to say that only by a masterly review of morphology, anatomy, physiology, distribution in time and place, and even of such subjects as chemistry and nutritive and physiological properties, have we been brought to an arrangement which commends itself to all who recognize and value a deciding influence higher than the dictum. Such inconvenience as results from working under the new arrangement may fairly be regarded as due to a failure to have taken natural relations into consideration. To those who have done so, the new arrangement will present no other unfamiliarity than that of a new thing which has been long and eagerly sought. As to beginning at the upper or lower end of the sequence, the reviewer confesses to but faint interest. It would appear to matter but little whether we turn to the right or to the left as we enter the herbarium. But it is of vital importance that those things should be brought together which show the closest relationship, and the acceptance or non-acceptance of any portion of the new arrangement may best be decided upon the basis of those principles upon which it has been founded. The following extract from the table of contents displays the arrangement of the families:*

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1. Ophioglossaceae	1	5. Polypodiaceae	8	9. Lycopodiaceae	39
2. Osmundaceae	4	6. Marsileaceae	33	10. Selaginellaceae	44
3. Hymenophyllaceae	6	7. Salviniaceae	34	11. Isoetaceae	45
4. Schizaeaceae	7	8. Equisetaceae	35		

SPERMATOPHYTA 49

Gymnospermae 49

* Underneath this table the authors print another, in which the common or English names of the families are substituted.

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It is incidentally to be regarded as fortunate that this arrangement brings before our students in the first volume those families which are usually regarded as most difficult. By the aid of this volume, any field-student or collector can, during the coming months, and before the appearance of the remaining volumes, become fairly well acquainted with the representatives of these difficult groups which are afforded by his locality.

The work will doubtless be assailed by a certain class because of the narrowness with which the species-limits have been drawn. On this subject it may be well to quote the authors: "The present tendency of expert opinion is to separate more freely into convenient natural groups, as genera and families, according to similarity of structure, habit, form or appearance." (Introduction, p. v.) And it may be further remarked that the tendency to unite species is manifested rather by those who act as editors; to separate them, by those who pursue special studies. In the performance of this portion of the work, Dr. Britton has been exceptionally well situated. During the six years that this work has been under way, he has been surrounded by a large and energetic group of workers, trained and held together largely through the influence of the Torrey Botanical Club. These men and

women have gladly undertaken from time to time the investigation of difficult or of poorly-known groups, and they have almost without exception brought to bear upon their work every modern method of research. This period has been noted farther for great activity in similar work throughout the country. An unusual amount of material in the way of field-notes has also been recently accumulated, a large part of it directly in the interest of this work. All this material has been assiduously studied. Although some of the cases of species-division appear surprising, yet in view of the minuteness with which the authors have conducted their studies, it may well be that such criticisms as shall be made will possess the demerit of being based upon a lower degree of scrutiny than the determinations themselves.

That the possibility of determining a plant by merely turning to a figure may induce habits of superficiality, is perhaps, true, though hardly so in case of such a work as this. Even in case of those fragmentary illustrated works which may be regarded solely or chiefly in the light of picture books, it is probable that the habits of observation and comparison they induce and develop more than counteract any such tendencies to superficiality; but in the present case every influence tends to lead the student on to deeper examination and more scientific methods. Reference has already been made to the illustration of the minuter structures beside the general illustrations. Even more important in this direction are the keys to the groups, so freely furnished as to form a complete system. No one, having learned to use botanical language, would of course think of consulting the cuts until the possibilities of the text—that of the keys, at least—had been exhausted. Those others, who may at first resort to the pictures, will, doubtless, quickly learn that time is usually saved by a different course, and a study of botanical terminology introductory to the use of the keys will almost surely follow. If there be some to whom this statement does not apply, the defect may be regarded as natural, and displayed in spite rather than because of the character of the book.

Keys, if not usually artificial, are pretty likely to accomplish their purpose the better in proportion as they are so. There is, however, in the keys of this flora an evident design of combining

the advantages of a scientific relation and an artificial characterization, an attempt in which there is no end of room for the exercise of ingenuity. The result is that in most of them we note a combination of obvious "ear-marks" with more complex characters.

It is needless to say that the rules of nomenclature followed are those which have been officially adopted by American botanists and which are evidently in the near future to dominate botanical writings abroad as well as in America. The code is printed and briefly explained in the introduction. In a foot-note reference is made to the principal American contributions to the subject of nomenclature. The authors would here have done well to include one by the writer, who has labored diligently in the interest of this movement, especially in medical literature. It appeared in the *Bulletin of Pharmacy*, and set forth clearly and fully the history of the movement in this country. The importance of applying some system in the application of family names is urged, but its introduction, in advance of full discussion and official adoption, is wisely omitted.

The forms of type, use of capitals and symbols and rules of pronunciation are also here briefly explained.

Throughout the book the accent is indicated in botanical names, specific as well as others.

Much care has been devoted to the selection of the common names, which have also been printed in a separate index. It is hardly to be hoped that a high degree of satisfaction will be given in this direction. Those whose botanical work brings them into especial communication with those who speak of plants by their common names learn to be quite hopeless about satisfying local ideas (and this the authors have not attempted), except by devoting to synonyms an amount of space quite out of the question in such a work. The propriety of excluding a common name of general acceptance because it is misleading as to relationship, as, for example, "Dog's-tooth Violet," may well be questioned. Common names are common property, and where the advisability of having them disturbed on scientific grounds has been officially considered, as, for example, by the National Bureau on Geographical Names, it has been decided indefensible. Upon the other

hand, when this is done by such a work as the Illustrated Flora, it serves the very useful purpose of reminding those who use such names that they are opposed to scientific authority, sufficient in many cases to lead to their disuse.

In the index to the botanical names the admirable system is followed of indexing the species as well as the genera and families.

The closing thought, that the two remaining volumes require only printing and binding, is by no means the least pleasing with which we regard the present occasion.

H. H. Rusby.

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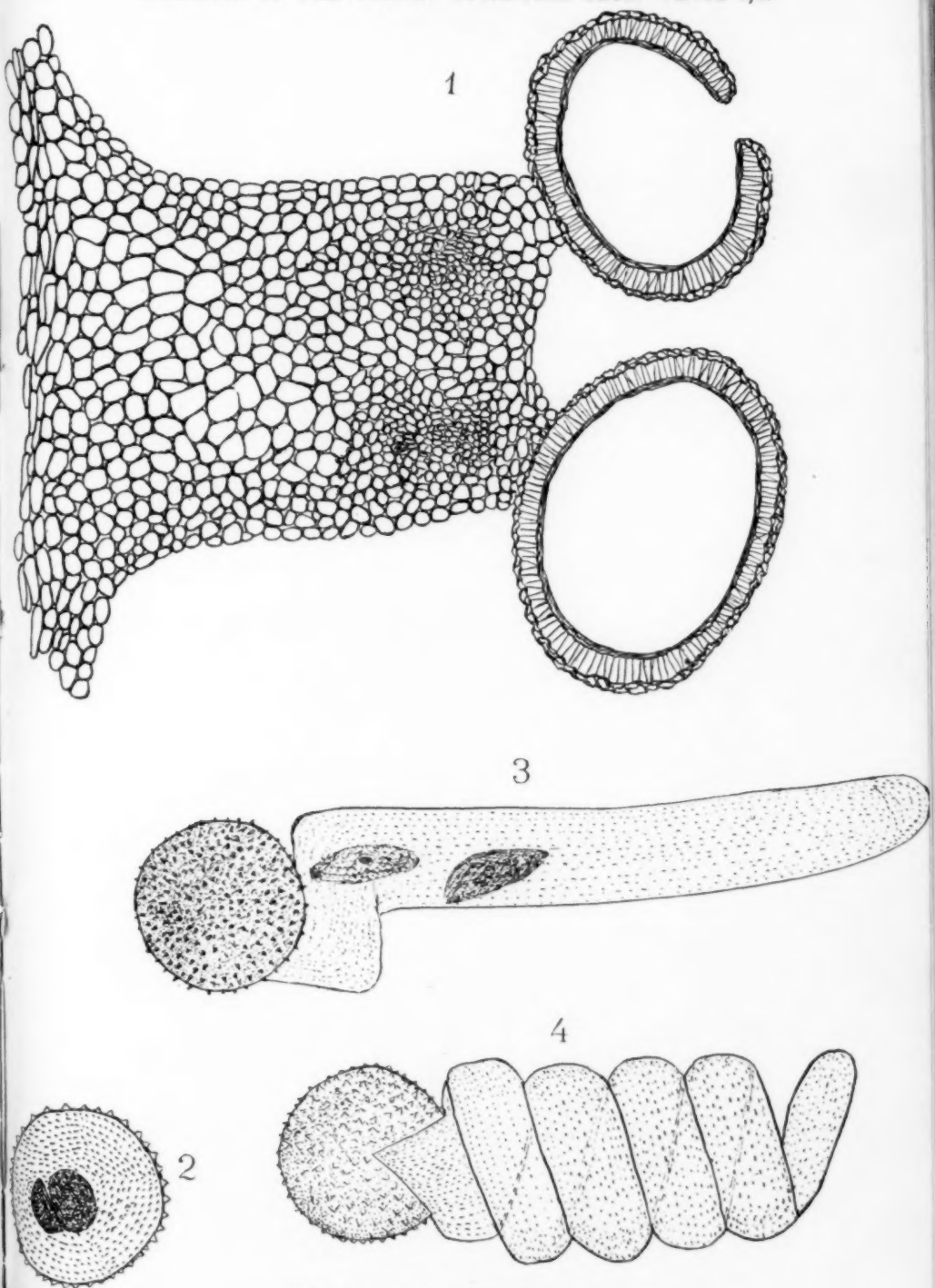

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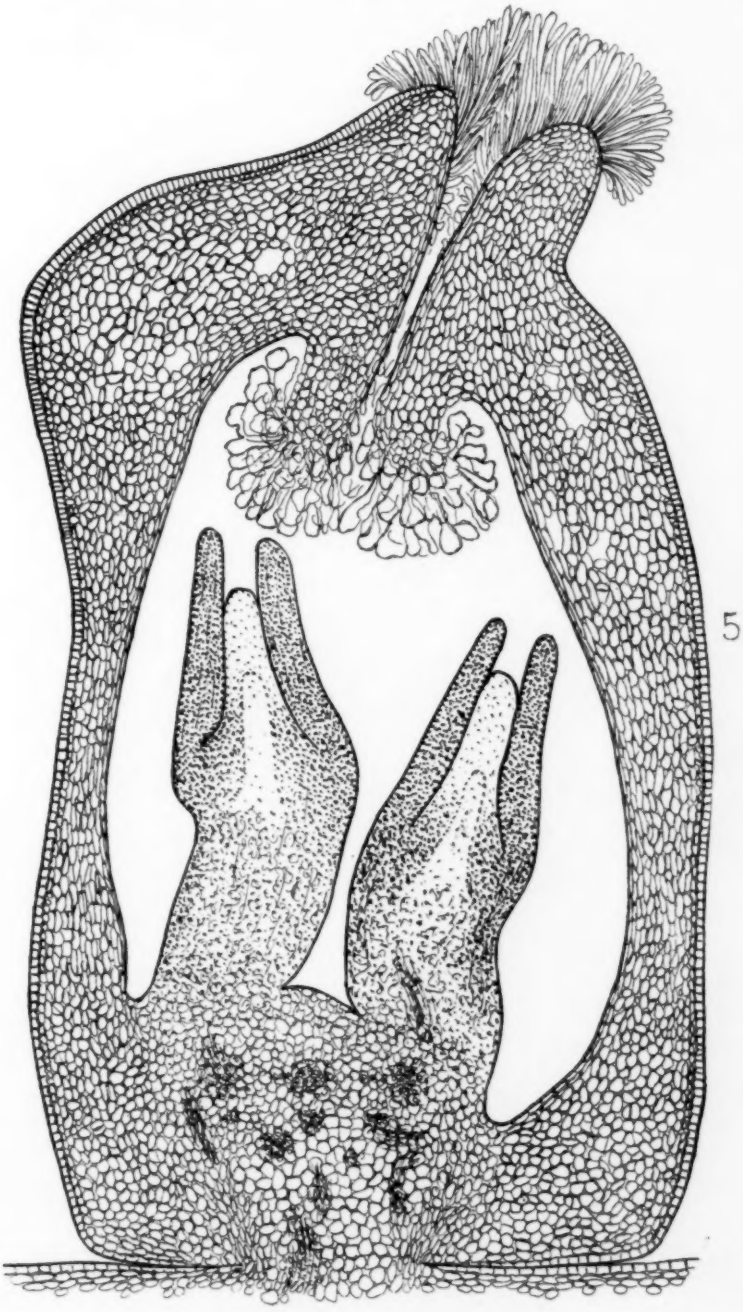

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